

CLAIM AMENDMENTS

1. (Currently Amended) A semiconductor optical device comprising:
a waveguide layer including two cladding layers and an active layer sandwiched between the two cladding layers; and
a reflecting multi-layer film ~~formed~~ including a plurality of layers and disposed on at least one of a pair of opposing end faces of the waveguide layer, wherein
a summation $\Sigma n_i d_i$ of products $n_i d_i$ of refractive ~~index~~ indexes n_i and ~~film thickness~~ thicknesses d_i ~~for each of a layer denoted with i-th~~ for each of i layers of the reflecting multi-layer film, and a wavelength λ_0 of light guided through the waveguide layer satisfies a ~~relationship~~:

$$\Sigma n_i d_i > \lambda_0/4, \text{ and}$$

~~wherein~~ a first wavelength bandwidth $\Delta\lambda$ is wider than a second wavelength bandwidth $\Delta\Lambda$, the first wavelength bandwidth $\Delta\lambda$ being a wavelength range including the wavelength λ_0 in which a reflectance R of the reflecting multi-layer film is not higher than +2.0% ~~from~~ of reflectance R at the wavelength λ_0 , the second wavelength bandwidth $\Delta\Lambda$ being a wavelength range including the wavelength λ_0 in which a reflectance R' of a hypothetical layer is not higher than +2.0% from reflectance R' at the wavelength λ_0 of a hypothetical layer having a thickness ~~of~~ $5\lambda_0/(4n_f)$ ~~of~~ a refractive index n_f formed, disposed on the at least one of opposing end faces ~~satisfies a relationship~~, and satisfying

$$R' = ((n_c - n_f)^2 / (n_c + n_f)^2)^2,$$

~~wherein the~~ where n_c denotes an effective refractive index of the waveguide layer.

2. (Currently Amended) A semiconductor optical device comprising:
a waveguide layer including two cladding layers and an active layer sandwiched between the two cladding layers; and
a reflecting multi-layer film ~~formed~~ including a plurality of layers and disposed on at least one of a pair of opposing end faces of the waveguide layer, wherein
a summation $\Sigma n_i d_i$ of products $n_i d_i$ of refractive ~~index~~ indexes n_i and ~~film thickness~~ thicknesses d_i ~~for each of a layer denoted with i in~~ for each of i layers of the reflecting multi-layer film, and a wavelength λ_0 of light guided through the waveguide layer satisfies a ~~relationship~~:

$$\Sigma n_i d_i > \lambda_0/4,$$

~~wherein a ratio~~ $\Delta\lambda/\lambda_0$ is not lower than 0.062, ~~the~~ and
reflectance R in the bandwidth $\Delta\lambda$ ranges from -1.0% to +2.0% ~~of the~~
reflectance R at the wavelength λ_0 .

3. (Currently Amended) A semiconductor optical device comprising:
a waveguide layer including two cladding layers and an active layer sandwiched between the two cladding layers; and
a reflecting multi-layer film ~~formed~~ including a plurality of layers and disposed on at least one of a pair of opposing end faces of the waveguide layer, wherein
a summation $\Sigma n_i d_i$ of products $n_i d_i$ of refractive ~~index~~ indexes n_i and ~~film thickness~~ thicknesses d_i of ~~a layer each of denoted with i in layers of~~ the reflecting multi-layer film, and
a wavelength λ_0 of light guided through the waveguide layer satisfies ~~a relationship:~~
$$\Sigma n_i d_i > \lambda_0/4,$$
 and
~~wherein a ratio $\Delta\lambda/\lambda_0$ is not lower than 0.066, the and~~
reflectance R in the bandwidth $\Delta\lambda$ ranges from -1.5% to +1.0% of the reflectance R at the wavelength λ_0 .

4. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein the reflecting multi-layer film includes a first ~~film layer~~ layer having a refractive index larger than a square root of an effective refractive index n_c of the waveguide layer and a second ~~film layer~~ layer having a refractive index smaller than the square root of the effective refractive index n_c .

5. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 4, wherein the first ~~reflecting-film layer~~ layer and the second ~~reflecting-film layer~~ layer are layered alternately.

6. (Currently Amended) ~~A~~ semiconductor optical device according to claim 1, wherein a first-layer ~~film~~ of the reflecting multi-layer film, which is in contact with the waveguide layer, has a refractive index smaller than a square root of an effective refractive index n_c of the waveguide layer.

7. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein the reflecting multi-layer film includes at least three layers made of ~~material~~ materials different from each other.

8. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein the reflecting multi-layer film includes seven ~~films~~ layers.

9. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein the reflecting multi-layer film includes six ~~films~~ layers.

10. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein the reflecting multi-layer film includes nine ~~films~~ layers.

11. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein a first-layer film of the reflecting multi-layer film, in contact with the waveguide layer, has ~~the highest~~ a heat conductivity in the films in higher than other layers of the reflecting multi-layer film.

12. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein a first-layer ~~film~~ of the reflecting multi-layer film ~~is~~, in contact with the waveguide layer ~~made of,~~ is aluminum nitride.

13. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein ~~a minimal~~ minimum value of the reflectance of the reflecting multi-layer film is within range from 1% to 32%.

14. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein a first-layer ~~film~~, which is in contact with the waveguide layer, and a second-layer ~~film~~ of the reflecting multi-layer film have a refractive index smaller than a square root of an effective refractive index n_c of the waveguide layer.

15. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein the reflecting multi-layer film includes eight ~~films~~ layers.